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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/601,540	09/06/2000	David Tomanek	6550-000017	4174

7590 09/05/2002

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EXAMINER

BRITTAIN, JAMES R

ART UNIT	PAPER NUMBER
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3677

DATE MAILED: 09/05/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

09/601,540

Applicant(s)

TOMANEK ET AL.

Examiner

James R. Brittain

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 8/1/00, 5/7/02, 5/28/02.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1,9,14 and 24-66 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 44-51 is/are allowed.
- 6) ☒ Claim(s) 1,9,14,24-29,31-42 and 52-65 is/are rejected.
- 7) ☒ Claim(s) 30,43 and 66 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

### Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Allowable Subject Matter***

The indicated allowability of claims 1, 9, 14, and 24-43 is withdrawn in view of a review of the teachings of Ihara et al. (US 5464987) and Yakobson et al. (*Fullerene Nanotubes: C<sub>1,000,000</sub> and Beyond*) and review with respect to 35 U.S.C. 112, first paragraph. The inconvenience to applicant is regretted.

### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1, 37, and 38 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The limitation stating that the extending nanotubes from each element become mechanically interconnected "without requiring the degradation of said nanotubes" (claim 1, lines 7-8) fails to comply with the written description requirement. The quoted portion was added by way of amendment to claim 1 submitted August 1, 2000 in the paper entitled Reply to Written Opinion and Article 34 Amendment. There is no basis in the specification to indicate in growing the open-ended nanotubes that there is no degradation in harvesting the nanotubes. The specification as filed is silent and does

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not prohibit degradation of the nanotubes in the formation of the open end or the capping of the other end.

Claims 37 and 38 indicate that the nanotubes are functionalized during (claim 37) or after (claim 38) attachment of the nanotubes to the substrate. These claims depend from claim 35 that states "non-linear" nanotubes are introduced to the substrate whereby they are attracted to the substrate and become affixed thereto. The nanotubes are claimed in claim 35 as already non-linear before they are attracted to the substrate and become affixed thereto. The nanotubes are shaped by being functionalized prior to attachment to the substrate. Claims 35, 37 and 38 were added by way of amendment submitted August 1, 2000 in the paper entitled Reply to Written Opinion and Article 34 Amendment. There is no basis in the specification to indicate that the "non-linear" nanotubes are further functionalized at the moment of attachment to the substrate or subsequent to attachment to the substrate.

Claims 37, 38, 59 and 60 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

These claims indicate that the nanotubes are functionalized during (claims 37, 59) or after (claims 38, 60) attachment of the nanotubes to the substrate. The specification describes the process by which the fastener is made on page 4, line 31 through page 5, line 18). This passage begins, "Upon growing the carbon nanotube to the desired length and shape..." and continues with capping the end so that "the formed

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fastening element 12 becomes substantially inert" and then attaching the fastening element to the substrate. The fastening element identified by reference numeral in the figures has been shaped by being functionalized prior to capping and attachment to the substrate. These claims are directed to two methods wherein the steps by which formed nanotubes are functionalized occur at the moment of attachment or after attachment. The methods by which this is accomplished are unstated. The disclosed method of shaping by being functionalized takes place during the growing of the nanotube to form the fastening element and is prior to its attachment to the substrate.

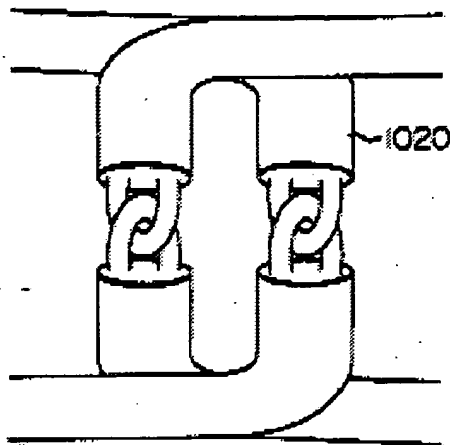
***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 9, 24-29, 31-34, and 52-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ihara et al. (US 5464987) in view of Yakobson et al. (*Fullerene Nanotubes: C<sub>1,000,000</sub> and Beyond*).

Ihara et al. (figure 10) teaches a microfastening system comprising a first fastening element comprising two half tori secured to a lower substrate comprising the two surfaces facing upward interengaging with two half tori secured to an upper substrate comprising the two surfaces facing downward. The middle portion of figure 10 is reproduced below.



The toriodal molecules are carbon nanotubes that include pentagons and heptagons to provide their curvature as shown in figure 1 and are therefore considered functionalized. The nanotubes are mechanically interconnected as shown in the above figure. Ihara et al. also teach that nitrogen and boron atoms can be added to provide added curvature such as helically-coiled structures that are recognized as molecular springs and thus deformable (col. 13, lines 19-36). The differences are that Ihara et al. indicate how the half-tori are harvested by dividing toroidal molecules in two and then fixing the molecules in opposite directions to each other (col. 8, lines 4-13) possibly providing for degradation of the nanotubes in the process of harvesting the nanotubes and the half-tori aren't explicitly stated as being deformable. However, the final product shows a mechanical interconnection of nanotubes connected to opposite substrates. The determination of the patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process. *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). Therefore, the final

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product as taught by Ihara et al., which provides for a strong mechanical connection inherently the limitation of providing a mechanical interconnection without degradation of the nanotubes since a strong mechanical interconnection is generated by the device of Ihara et al. Further, the deformability of nanotubes is an inherent characteristic well known in the art as evidenced not only by Ihara et al. (col. 13, lines 19-36) but in view of Yakobson et al. (pages 329-331) which further establish the acceptance of the nanotube structures as being well known for withstanding all sorts of twisting and bending (page 331, col. 2, lines 20-22). It would have been obvious to recognize that the mechanical interconnections of Ihara et al. are deformable in view of the teaching of Ihara et al. and Yakobson et al. that indicate the well known deformability of nanotubes. The interconnection is selectively deformable by placing stress on the connection so as to elastically deform the loops.

The half-tori of Ihara et al. are clearly non-linear and form loops that comprise a comparable configuration to that shown by applicant. Further, with respect to claim 52, the functionalized non-linear nanotubes of Ihara et al. have one end defined by the two open ends of each half-torus that is joined to the substrate and an intermediate end distal the substrate that is free of the surface of the substrate. The structure forms a loop and explicitly meets the loop limitation of claim 55 that depends from claim 52.

Ihara et al. doesn't explicitly teach what the material of the substrate comprises for the mechanical connection of figure 10. However, it is taught that silicon is a material to which the molecules can be adsorbed. It would have been obvious to recognize from the teaching of Ihara et al. that silicon is a material to which the half-tori

molecules can be adsorbed. The use of multi-walled nanotubes for the mechanical fasteners would have been obvious since the structures are well known as evidenced by Yakobson et al. (figure 2) and the multiple walls would be desirable for their inherent greater strength thereby providing a stronger mechanical connection.

Claims 14, 35-42, and 57-65 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ihara et al. (US 5464987) in view of Yakobson et al. (*Fullerene Nanotubes: C<sub>1,000,000</sub> and Beyond*) as applied to claims 1, 9, 24-29, 31-34, and 52-56 above, and further in view of Rabinowitz (US 5697827).

Ihara et al. teach that the open ends of the half-tori are fixed to the substrate (col. 8, lines 4-13). It doesn't indicate that there is a step comprising attracting the half-tori to the substrate. Yakobson et al. also indicates that the ends of nanotubes must be sealed in order to avoid dangling "unhappy" chemical bonds (page 324, col. 2, lines 34-37). However, Rabinowitz (figures 13-15) teaches a method of securing nanotubes to a substrate (col. 17, line 30 - col. 18, line 45) by attracting them to the substrate through the use of an electric field that accelerates them to the substrate as being a well known method for securing nanotubes in an arrayed manner so as to be standing upon the substrate and extending therefrom. It would have been obvious to modify the fixing method of the half-tori of Ihara et al. so that the method of fixing includes attracting the half-tori to the substrate in view of Rabinowitz teaching a method of securing nanotubes to a substrate by attracting them to the substrate through the use of an electric field that accelerates them to the substrate as being a well known method for securing nanotubes in an arrayed manner so as to be standing upon the substrate and extending therefrom.



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In regard to the placement of the functionalizing step either at the time of attachment of the fastening elements to the substrate or after attachment to the substrate, these alternative methods of forming the fastener are seen as obvious to that taught by the combined teaching as suggested above, in the absence of any criticality of the ordering of the process steps.

***Allowable Subject Matter***

Claims 30, 43 and 66 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 44-51 are allowed.

***Response to Arguments***

Applicant's arguments filed August 1, 2000 have been fully considered but they are not persuasive. As to the argument that Ihara et al. requires a destruction of the atomic bonds to form the link, applicant provides no written description in his disclosure to indicate that harvesting the open-ended nanotubes is necessarily "without requiring the degradation of said nanotubes". Further, applications allegation of this being a difference from the product of Ihara et al. lacks evidence establishing an unobvious difference between the claimed product and the prior art product. *In re Marosi*, 710 F.2d 798, 802,218 USPQ 289, 292 (Fed. Cir. 1983). Further, applicant indicates that the device of Ihara et al. isn't selectively deformable. However, nanotubes are well known as being elastically deformable and the placement of stress upon the juncture

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shown by the mechanical connection of Ihara et al. would inherently selectively deform the loops when the stress is applied to the connection.


**Conclusion**

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The patents of Brown et al. (US 6340822), Green et al. (US 5346683), Wegrowe et al. (US 6172902), Smalley et al. (US 2002/0085968) (¶[0019]), and Chang (US 5916642) are cited as showing structures pertinent to this art.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to James R. Brittain whose telephone number is 703-308-2222. The examiner can normally be reached on Monday - Friday from 5:30 to 2:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, J. J. Swann can be reached on 703-306-4115. The fax phone numbers for the organization where this application or proceeding is assigned are 703-305-7687 for regular communications and 703-305-7687 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-1113.

  
James R. Brittain  
Primary Examiner  
Art Unit 3677

JRB  
September 3, 2002